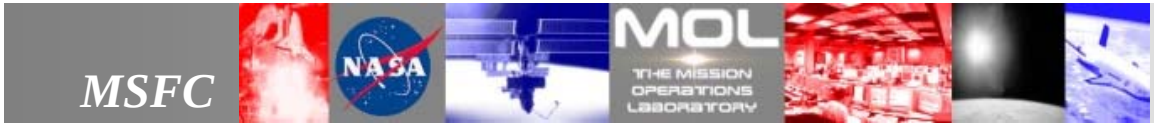

Ku - Band, DTN, and enhanced payload utilization

WHAT CAN BE DONE TO MORE FULLY UTILIZE PAYLOADS ON THE ISS

Historical payload perspective

- The ISS has two USA command paths
  - S-band
  - Ku-band
- Each path has limitations and benefits
  - S-band is slow
    - Utilizes 1553 commands
    - interfaces through payload MDM to express racks
    - HOSC has access only to US addressable payloads
  - Ku-band is faster
    - Has access to onboard VLANs
    - Bypasses MDMs
    - Access is limited to the Orbital Communications Adapter (OCA) and limited applicability to payloads now

Future utilization perspective

- In the past few years a number of activities have been undertaken concurrently
  - Obsolescence Driven Avionics Redesign (ODAR)
    - Upgrade the ISS links and internal support
    - Extend the ISS life span to 2020 and beyond
    - Upgrade the CCSDS protocols to support better utilization (732.0-B-2, 133.0-B-1, and 133.1-B-2)
  - Delay (Disruption) Tolerant Networking (DTN)
    - Has been maturing through usage and expansion by the NASA DTN WG, ISS DTN WG, and CCSDS as well as other non-space related users
    - DTN uses a standards based store and forward model to accomplish this type of capability

Ku - Band Utilization

- ODAR is nearing its final stages and as a result enhancements may be available to the payload community
  - Increased downlink
    - Up to 300 Mbps aggregate
    - Capability to downlink different protocols
  - Increased uplink opportunities designed in
    - Not only the ability to uplink via traditional S-band
    - Uplink can use new protocols on Ku-band
      - AOS standard (732.0-B-2)
      - IP Encap (133.0-B-1 and 133.1-B-2)
    - Ku-band uplink is not only for the Orbital Communications Adapter (OCA)
    - Payloads users can be provided access to devices on the payload VLAN via IP address

Ku - Band Utilization

- A Change Request (CR #13351) is working its way through the system and will allow Ku-band access to payloads via internet protocols
- Ku-band forward helps extend the HOSC remote user model from the user directly to payloads and payload infrastructure
  - ✓ Allows the use of IPv4 protocols
  - ✓ CADRE command line access to infrastructure items such as iAPS, ICU, iPeHG
  - ✓ Payload users can uplink files to their platforms allowing repurposing of payloads without upmass and minimal astronaut support
  - ✓ Payload users can have direct access to the payloads by IP address
  - ✓ Expands the benefits of DTN without compromising current capabilities

DTN Utilization

- The NASA ISS DTN WG is defining requirements for onboard and ground DTN standard services
  - Stabilizing the DTN protocols and codifying them in CCSDS standards
    - Bundle protocol specification CCSDS 734.2-R-1 (RFC 5050, 6260, ECOS, ACS, various CLAs) is red-1
    - Licklider protocol (RFC 5326) is red-2
    - Several others (Contact Graph Routing, Bundle Security Protocol)
    - Space Assigned Numbers Authority (SANA) with registries for appropriate services
  - Utilizing world-wide experience and NASA's DTN Engineering Network (DEN) to exercise the capability

DTN Utilization

- DTN provides enhancements to operations via a standard set of protocols
  1. A DTN network architecture providing a standards-based, publically available, space networking protocol to provide bi-directional communications for payload C&T systems
  2. DTN significantly improves communication link efficiency by ensuring science is successfully received at the destination with the minimum amount of data transmission
- DTN can be utilized by gradually increasing onboard capability
- A Change Request (CR #nnnnn) is in work to provide limited DTN capability to ISS payload users based on CCSDS requirements

Ku-band forward and DTN Utilization

- Potential:

1. ODAR capabilities and DTN can be used to decrease payload user labor via automation of payload command and telemetry (C&T) transmission and receipt
2. Ku-band forward and the DTN network stack supports industry-standard application code reuse expanding the applicability of payload on the ISS